Development of an Objective High Spatial Resolution Soil Moisture Index

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American Geophysical Union Fall Meeting
San Francisco, CA
December 15, 2015
Hydroclimate Extremes: Drought IV
Paper Number: H21O-05

Presentation Outline

- Motivation: high-resolution, real-time soil moisture for situational awareness of drought/flood potential
- Overview of Land Information System (LIS)
- 30-year LIS-Noah soil moisture climatology
- Validation against U.S. Drought Monitor
- Applications
- Summary and Future Activities

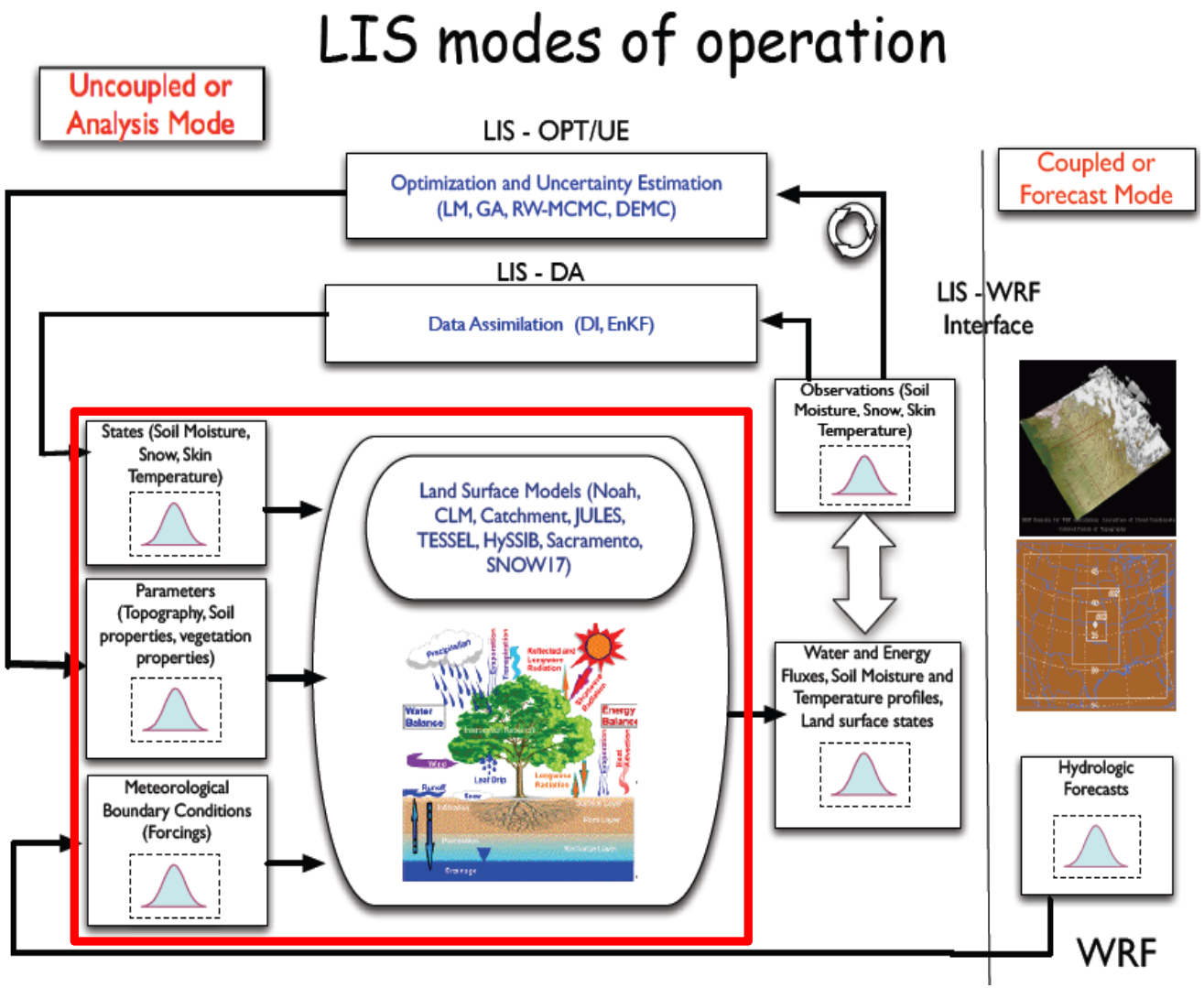
Overview of NASA Land Information System

High-performance land surface modeling & data assimilation system

Uncoupled/analysis mode

Forecast mode coupled to WRF model

We run Noah LSM in uncoupled/analysis mode



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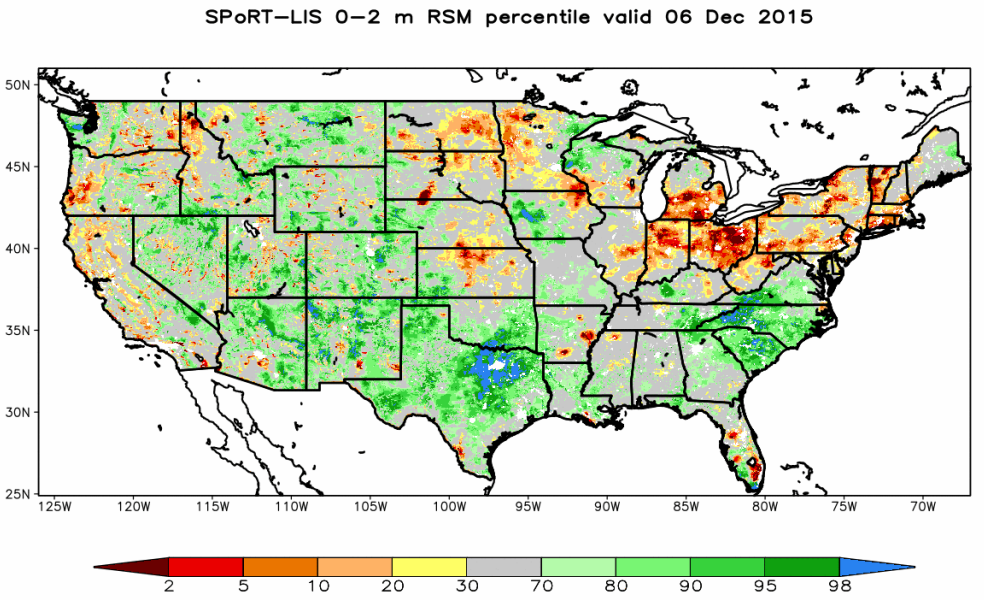
LIS-Noah 30-year Climatology Development

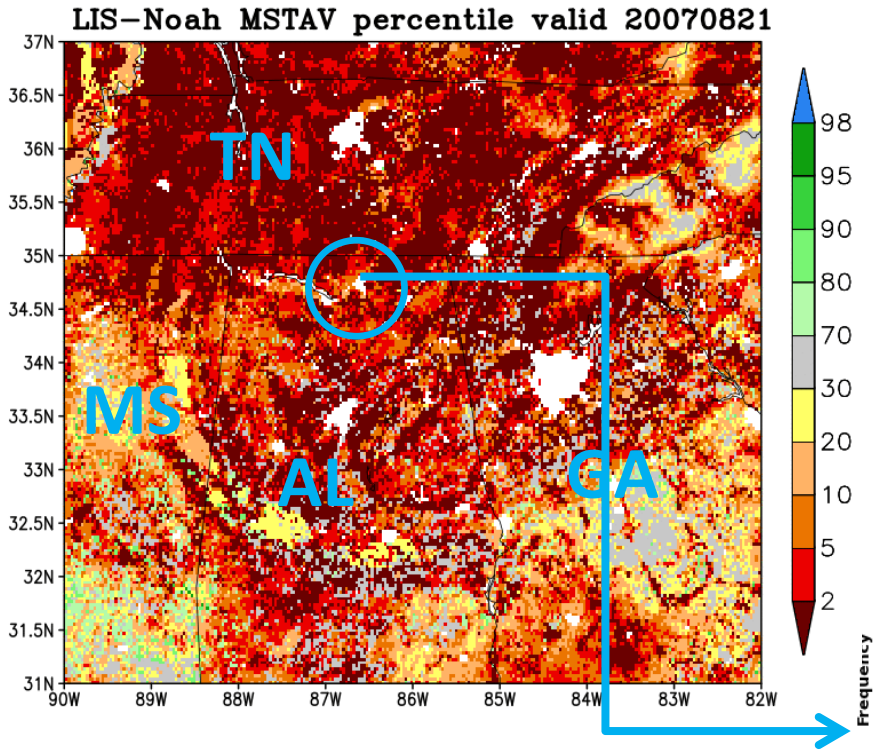
- **LIS-Noah run from Jan 1979 to Dec 2014**
  - CONUS+ domain at 0.03-deg resolution (~3 km)
  - IGBP/MODIS 20-class land use, STATSGO 16-class soil
  - MODIS/FPAR 30-sec resolution monthly GVF climatology (Barlage; from community WRF v3.5.1+)
  - Atmos. forcing: NARR-based NLDAS-2 hourly data
  - 2-year spin-up (1979-1980)
  - Output daily at 1200 UTC
  - Climatology spans 1 Jan 1981 to 31 Dec 2014 for more than 30 years of data



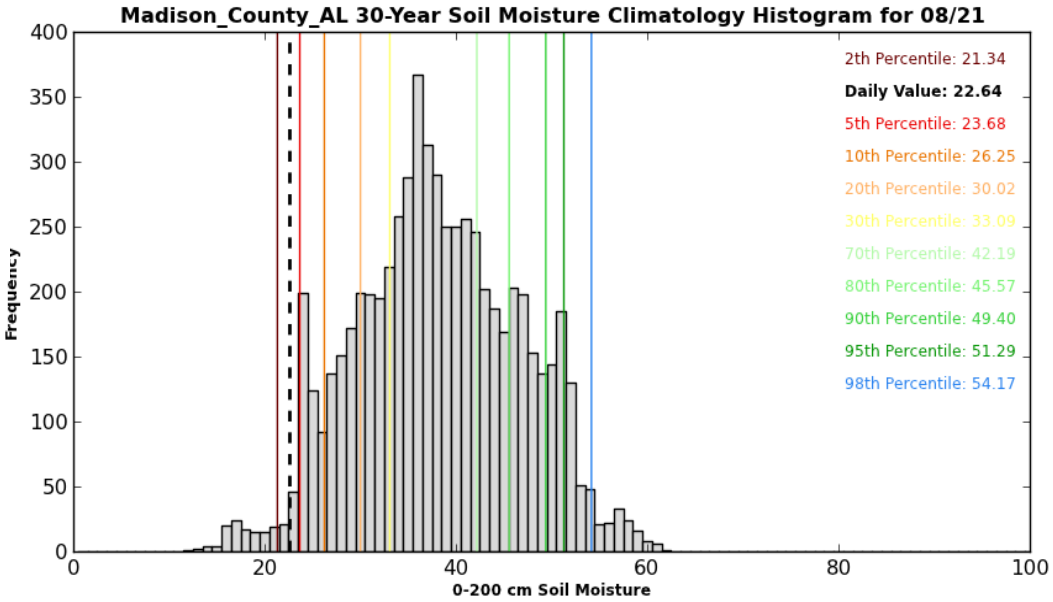
Daily Soil Moisture Climatology by County

- **Total column relative soil moisture (RSM; 0-2 m)**
- **Generate daily county histograms of 0-2 m RSM**
  - Group all LIS-Noah grid points within specific county using a U.S. Census Bureau county boarder shapefile
  - Generate histogram of 0-2 m RSM from all 30 years
  - Repeat for each day of year and all CONUS counties
- **Apply county-scale climatology to compute percentiles at all grid points for any given day**

Histogram and Percentile Map



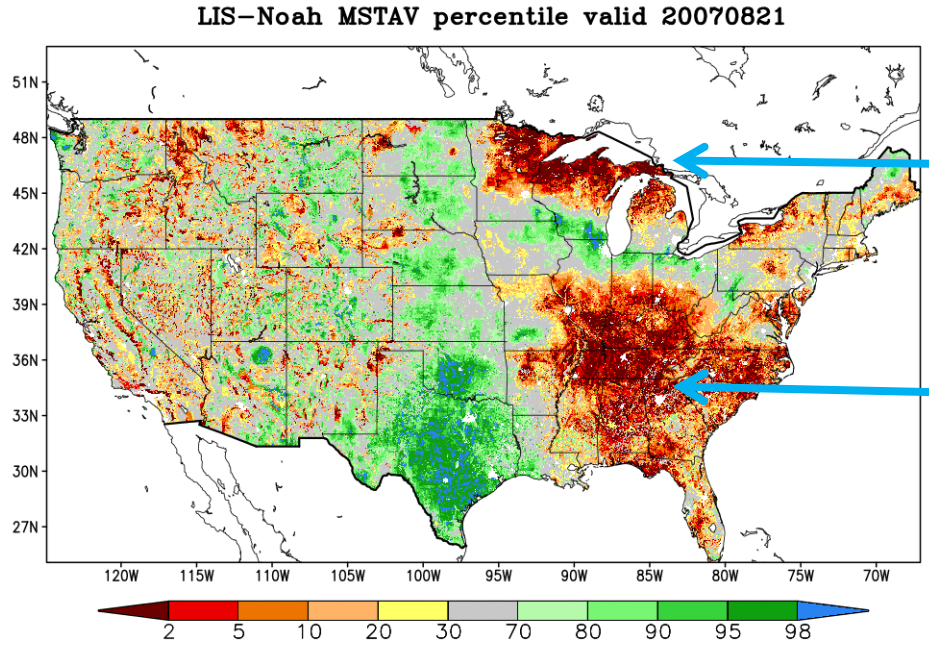
- 21 August 2007
- Southeast U.S. was under extreme drought conditions

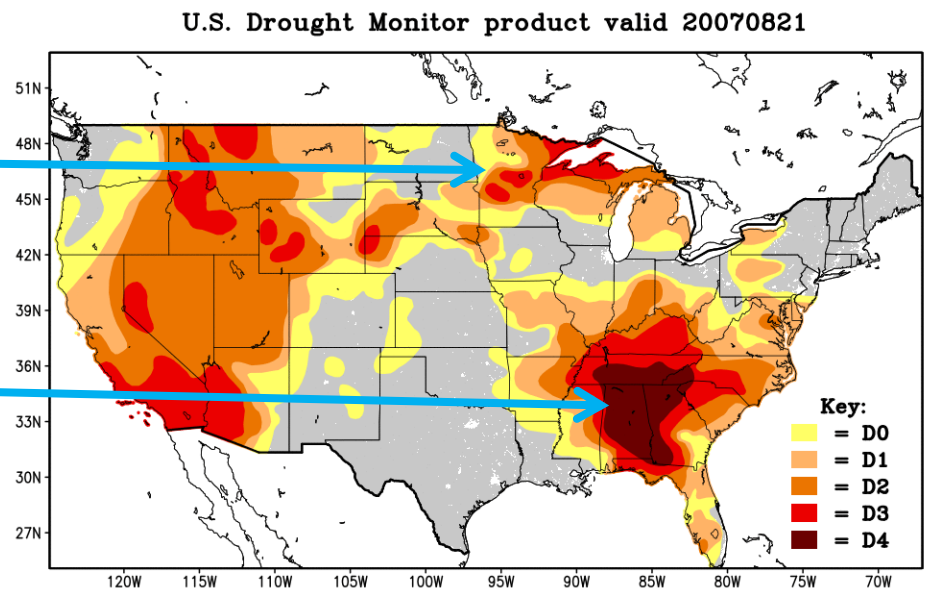


- **Proxy percentiles of USDM categories**
  - Similar to NLDAS-2 drought index in Xia et al. (2014; *JHM*)
  - Straight-up, uncalibrated 0-2 m relative soil moisture (i.e., available water)

D4<2% D3<5% D2<10% D1<20% D0<30%

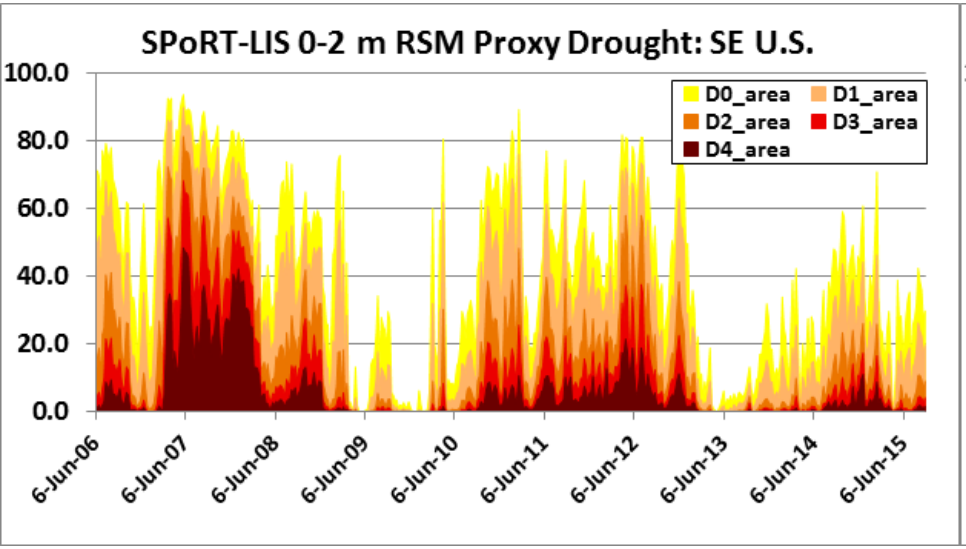
Soil Moisture Percentile Validation

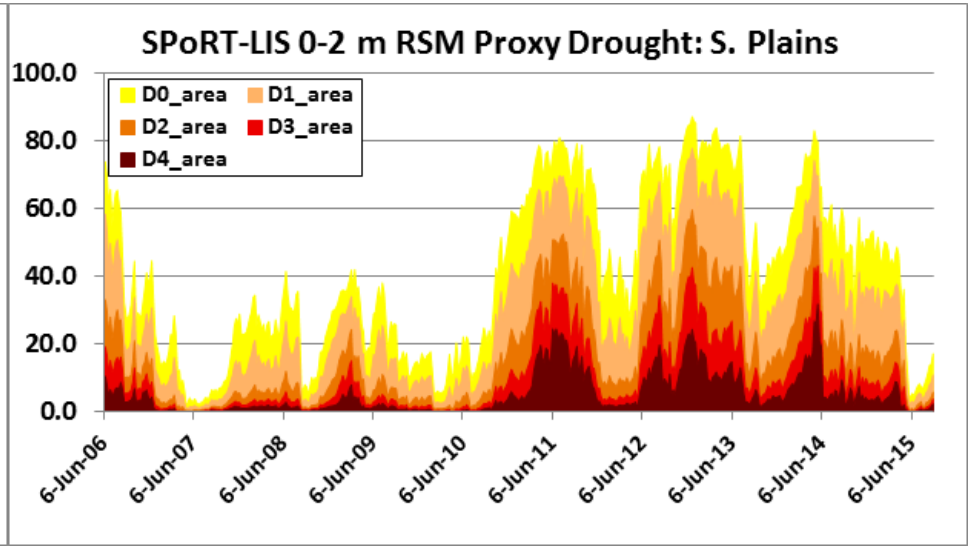




- Good correspondence in East on sample day
- LIS suggests worst soil moisture deficits extend NW of USDM D4 category
- LIS shows D4 proxy percentiles over western Great Lakes as well

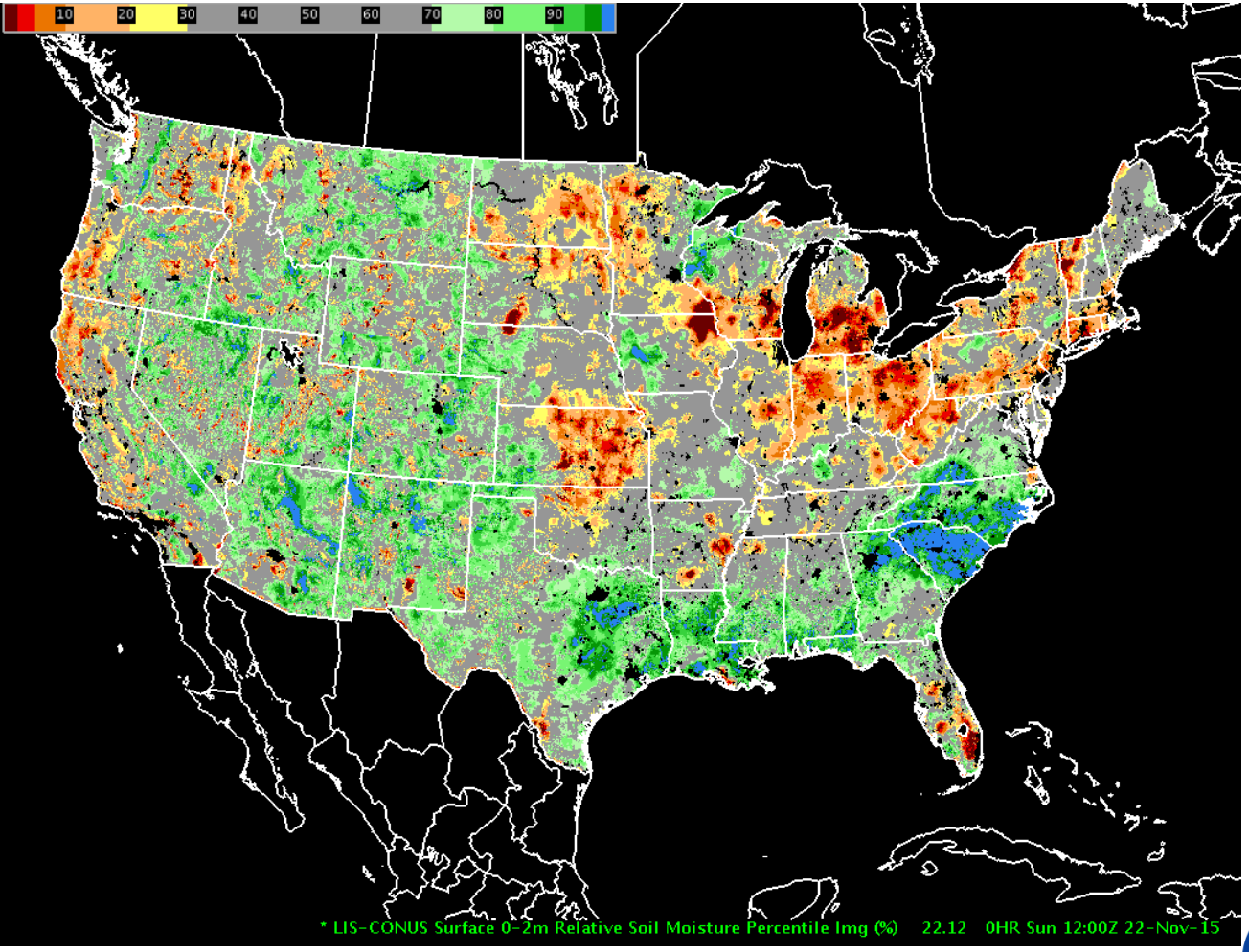
Soil Moisture Percentile Validation





Soil Moisture Percentile Application

SPoRT-LIS Percentile Product in National Weather Service AWIPS-II decision support system for 22 November 2015



- NWS issues flood watches and warnings
- NWS also contributes to the USDM and has made sub-county scale modifications based on LIS output

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Summary and Future Work

- **Summary**
  - The SPoRT project at NASA/MSFC produces a same-day, high-resolution drought index comparing 30 years of LIS climatology to the real-time SPoRT-LIS output
  - Gridded drought index product is provided to partnering forecasters at the NOAA/NWS in their AWIPS-II decision support system

- **Future Work**
  - Formal assessment of percentile product scheduled for spring/summer with SEUS WFOs
  - Investigate incorporation of snow water equivalent information into

Questions/Discussion

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